

Route Availability Planning Tool (RAPT)

Departure Delays in Convective Weather:

Small Improvements in Departure Rates, Big Difference in Departure Delays

When hazardous weather hits a crowded terminal airspace, substantial departure delays occur as departure routes are closed and arrivals are given priority (Fig. 1). Experienced FAA managers have noted that small increases in departure rates – as few as one or two flights per hour – can reduce delays significantly. Departure queuing models agree (Fig. 2).

Using high quality aviation weather forecasts from the Integrated Terminal Weather System (ITWS) or Corridor Integrated Weather System (CIWS) and observations of actual flight times from airport runways to points along standard departure routes, it is now possible to identify opportunities to increase departure rates safely in changing convective weather.

RAPT: Integrated Decision Support

RAPT is the first of a new generation of decision support tools that combine state-of-the-art weather forecasts with operational flight data (Fig. 3) to help users at the Tower, TRACON, Command Center and airlines answer the questions:

1. **Will a candidate future departure encounter hazardous weather at some point along its intended path?**
2. **Will there be opportunities to route the aircraft through gaps in evolving weather?**

Since the appearance of the Terminal Convective Weather Forecast (TCWF) in NYC ITWS in 1998, ATC personnel have had to answer these questions by **mentally extrapolating the forecast and calculating the future plane locations for each planned departure**. **RAPT automates these mentally taxing calculations**, making accurate departure impact predictions readily available to the supervisors and air traffic flow managers for all the important routes in the airspace. ATC personnel can spend their time making critical routing decisions instead of performing mental arithmetic.

Average Delays at EWR, Spring/Summer 1999-2000

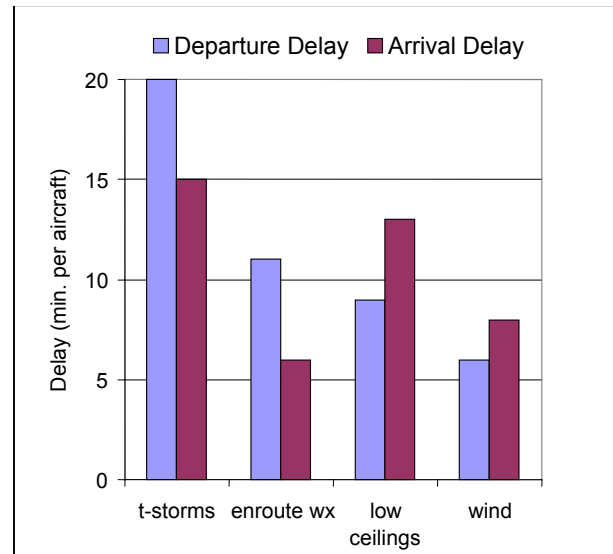


Figure 1. Hazardous weather in the terminal area and en-route corridors is a leading cause of departure delays in spring and summer. On days with hazardous weather impacts, departure delays, exceed arrival delays by more than 30%.

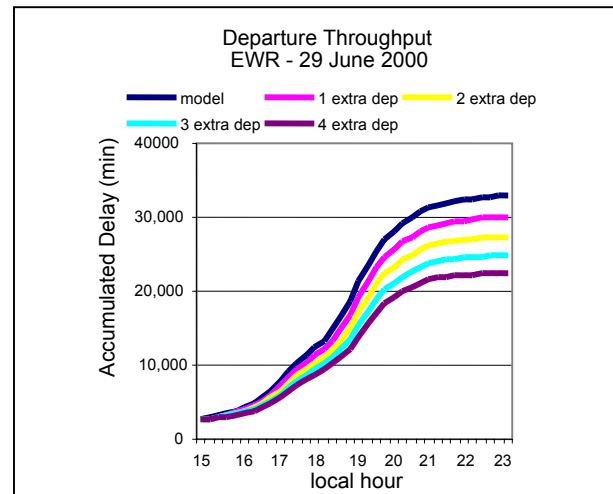


Figure 2. Over an 8 hour period, a single additional departure per hour resulted in a delay reduction of 10% (~50 hours); 3 additional departures reduced delays by 25% (135 hours).

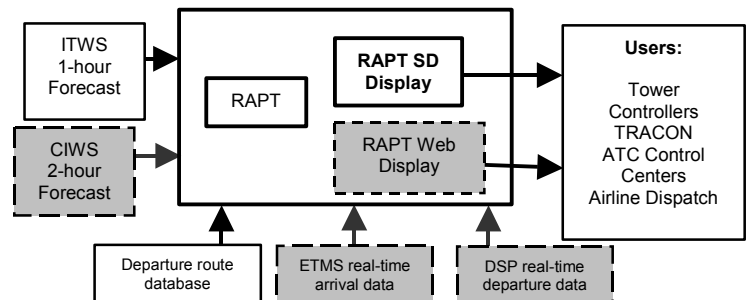


Figure 3. RAPT functional diagram. Shaded boxes indicate potential developments for 2003.

RAPT produces timelines for the various departure routes from each active runway at an airport. Each timeline gives the status (CLEAR, IMPACTED or BLOCKED) of future departures along a particular route. The RAPT display shows timelines, grouped by airport or fix (Fig. 4). Clicking on a departure time brings up a movie loop of the weather forecast and plane location for the selected departure time (Fig. 5), providing additional critical information about the feasibility of a departure at the candidate departure time.

Current Operations (2002)

RAPT began a real-time concept exploration evaluation with users in the New York and Washington, DC Control Centers (ZNY, ZDC), the New York TRACON (N90) and New York area control towers on August 14, 2002. Users began using RAPT to plan departures almost immediately and continue to be very enthusiastic.

Future Plans (2003)

RAPT will see extensive development in 2003:

1. Implementing user suggestions from the current demonstration
2. Connecting to the CIWS 2 hour Regional Convective Weather Forecast (RCWF)
3. Putting RAPT on the Web to facilitate airline dispatch access
4. Displaying projected arrival plane locations in the RAPT forecast movie loops
5. Incorporating estimates of forecast reliability into departure timelines

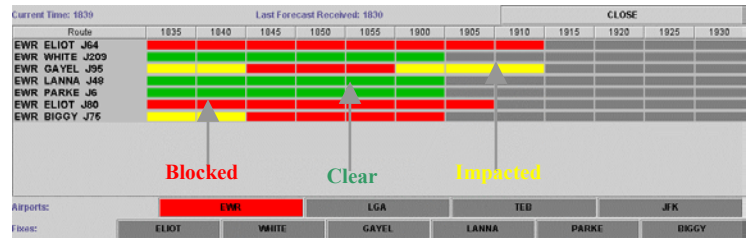


Figure 4. RAPT timeline display. Using the 1 hour ITWS hazardous weather forecast, RAPT predicts which future departures will be **BLOCKED** (red time blocks), **IMPACTED** (yellow) and **CLEAR** (green). Clicking on a block brings up a movie loop of the forecast and the selected departure.

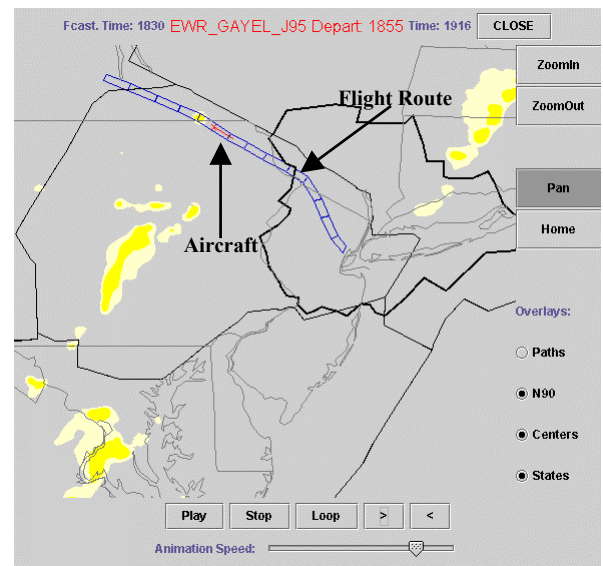


Figure 5. RAPT forecast movie loop display, showing hazardous weather (dark yellow), departure path and flight animation (red X) for a **BLOCKED** departure.

*For further information on RAPT, please contact
Rich DeLaura at (781) 981-4699 or richd@ll.mit.edu.*

The development of the RAPT was funded by the Port Authority of NY/NJ through a Cooperative Research and Development Agreement (CRDA) with MIT Lincoln Laboratory. Support has been provided by the FAA through ATC personnel participation in the RAPT users group.